

**DEPARTMENT OF NATIONAL DEFENCE
CANADA**



OPERATIONAL RESEARCH DIVISION

DIRECTORATE OF OPERATIONAL RESEARCH (JOINT & LAND)

ORD PROJECT REPORT PR-9710

**PERFORMANCE MEASURES FOR THE DND FLEET
OF MOBILE SUPPORT EQUIPMENT**

by

M. Provencher

OCTOBER 1997

OTTAWA, CANADA



**National Défense
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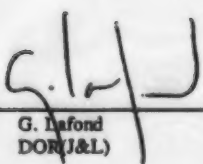
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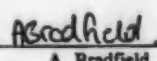
by

M. Provencher

Recommended by: _____


G. Lafond
DOR(J&L)

Approved by: _____


A. Bradfield
DGOR

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OTTAWA, ONTARIO

OCTOBER 1997

ABSTRACT

Data on the Department of National Defence (DND) fleet of vehicles were analysed from the point of view of performance analysis. The report identifies productivity measures in fleet management. These measures are applied to actual data and their validity, accuracy, and completeness as a set of measures are discussed. Utilisation measures were evaluated and showed that the DND fleet performs better than the industry for some commercial-like vehicles such as station wagons and highway tractors. The performance of light trucks however is below industry average. It was also noted that the median base transportation section has about two drivers for every support individual. Improvements need to be made on the quality of the information gathered and the way it is compiled.

RÉSUMÉ

Des données de la flotte de véhicules du ministère de la Défense nationale (MDN) ont été analysées du point de vue de l'analyse de performance. Ce rapport identifie des mesures de productivité en gestion de flotte de véhicules. Ces mesures sont appliquées sur des données réelles et leur validité, leur précision, et le caractère exhaustif de l'ensemble des mesures sont discutés. Des mesures d'utilisation ont été évaluées et ont montré que la flotte du MDN accomplit davantage que l'industrie pour certains véhicules de type commercial tels que les voitures familiales et les tracteurs de semi-remorques. La performance des camions légers est cependant sous la moyenne industrielle. Il fut aussi noté que la section de transport d'une base médiane a environ deux chauffeurs pour chaque employé de soutien. Des améliorations sont nécessaires au niveau de la qualité de l'information recueillie et la façon dont elle est compilée.

EXECUTIVE SUMMARY

In the fall of 1996, a study on productivity measures in transportation was requested by the Directorate of Transport and Movements (DTM). Fleet management was one area of transportation that was to be addressed. This report specifically identifies productivity measures in the area of fleet management. These measures are applied to actual data and their validity, accuracy and completeness as a set of measures are discussed.

DTM manages 9 879 standard commercial pattern mobile support equipments, 63% of which are general purpose vehicles such as sedans, vans, or trucks.

Performance was evaluated through three measures of vehicle utilisation:

- a. the number of vehicles used over the total number of vehicles;
- b. the number of kilometres driven per month per vehicle; and
- c. the hours of ready time per month per vehicle.

The materiel handling equipment, general purpose vehicles, construction equipment and fire fighting vehicles all had basic utilisation rates of 80% or higher. Compared with the industry, the average number of kilometres per month was higher in DND for the station wagons and highway tractors. It was lower for the light trucks. Comparisons were made amongst bases relative to group averages. The hours a vehicle is idle but ready to operate per month (as opposed to the hours a vehicle is idle waiting for or being repaired) would be useful if the hours were recorded according to the operational hours of the vehicle.

Performance was also measured in terms of personnel utilisation: the ratio of the number of drivers to the number of non-drivers in each transportation section. It showed that the median transportation section has a little more than two drivers for each support person.

Recommendations were made on data gathering and particularly on the information system. The right type of information is gathered, however its quality and the way the information is stored, need to be improved.

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LIST OF ABBREVIATIONS

AG	Auditor General of Canada
AVIMS	Automated Vehicle Inventory Management System
CF	Canadian Forces
CFB	Canadian Forces Base
CFR	Canadian Forces Registration
CFSU(O)	Canadian Forces Support Unit (Ottawa)
DND	Department of National Defence
DTM	Directorate of Transport and Movements
ECC	Equipment Configuration Code
GPV	General Purpose Vehicle
LOMMIS	Land Ordnance Maintenance Management Information System
MHE	Materiel Handling Equipment
MSE	Mobile Support Equipment
NAFA	National Association of Fleet Administrators
PAX	Passenger
pcBATOPS	pc Base Automated Transportation Operating Systems
SC	Standard Commercial
SMP	Special Military Pattern
SPV	Special Purpose Vehicle
VMIS	Vehicle Management Information System
VOR	Vehicle Off the Road

ACKNOWLEDGEMENT

I would like to thank Capt Neil Glockling whose quick and keen response to my requests have helped significantly in the analysis of the fleet data.

PERFORMANCE MEASURES FOR THE DND FLEET OF MOBILE SUPPORT EQUIPMENT

I. INTRODUCTION

1. In October 1996, a study on productivity measures in transportation was requested by the Directorate of Transport and Movements (DTM) [1]. Five key areas of transportation were to be addressed: personnel transportation, furniture and effects, postal services, operational movements - materiel traffic, and fleet management. These areas reflect the current composition of DTM. This report identifies productivity measures in the area of fleet management. These measures are applied to actual data and their validity, accuracy and completeness as a set of measures are discussed.

2. The scope of fleet management, the current holding, and the information gathered on DND vehicles and drivers were reviewed from a performance analysis perspective. This report presents the findings, the performance measures adopted and evaluated, and some recommendations on desirable information to gather and measure in the future such as the use of taxis and rental equipment.

II. HOLDING

3. DTM manages 9 879 standard commercial pattern vehicles across more than 20 Canadian Forces Bases (CFB). Of these 9 879 mobile support equipments (MSE), 63% are general purpose vehicles (GPV), i.e., sedans, vans, 1 1/2 ton trucks and miscellaneous cargo vehicles. The remaining standard commercial pattern vehicles are: special purpose vehicles (SPV) such as fire fighting vehicles and construction equipment, materiel handling equipment (MHE) like forklifts, trailers, and locomotives (we have only three of the latter).

4. DTM manages all the standard commercial pattern vehicles but monitors the others, a total of 30 134 MSEs i.e., the total CF inventory of vehicles, including tanks and armoured personnel carriers. VMIS, the Vehicle Management Information System described in [2], provided the current holding. VMIS is the information system used for fleet management by DTM. It draws information from three other information systems: AVIMS on vehicle inventory and history, LOMMIS on vehicle maintenance and engineering data, and pcBATOPS on the utilisation of CF vehicles. pcBATOPS is the system used by base transportation for its operations. For this reason it provides the most important information on the utilisation of resources. However, the transfer of information from pcBATOPS to VMIS is not automatic. It is done monthly either through electronic mail or diskettes. Some bases do not report the information, others do it but inconsistently.

5. Each vehicle has a unique Canadian Forces Registration (CFR) Number. Associated to that number is an equipment configuration code (ECC). For example the vehicle with CFR number 88-94979, a Plymouth model number SHL52, belonging to CFB Kingston has an ECC of 140146. This ECC designates a vehicle with the following characteristics: liquid propane gas, 4x2, i.e., 4 wheels & 2-wheel drive, 5 passengers (PAX) with driver as listed in the Cost Factors Manual [3]. Another vehicle with this same ECC of 140146 is a Chevrolet, model number CM10906, located at CFB Edmonton. Even though ECCs regroup a number of vehicles, they are still very specific. The ECCs are grouped into 11 categories as shown in Table I. Note that ECC group 8 represents trailer type shelters and so does not belong with MSEs intrinsically. The number of vehicles under each category is presented as a histogram in Figure 1. The stocks of most interest are the standard commercial pattern MSEs since they fall under DTM's responsibility.

TABLE I

ECC GROUPS

* indicates military type

ECC Group	ECC Range	Vehicle Group - General Description
1	100000-109999	Material Handling Equipment
2 *	110000-119999	Armoured Vehicles
3 *	120000-129999	Special Military Pattern (SMP)
4 *	130000-139999	Trailers SMP
5	140000-149999	Personnel/Cargo Move, Standard Commercial (SC)
6	150000-159999	Trailers SC
7	160000-169999	Construction Equipment
8	170000-179999	Trailer Type Shelters
9	180000-189999	Crash/Fire Fighting Vehicles
10	190000-199999	Locomotives
11 *	200000-899999	Light/Heavy Weapons

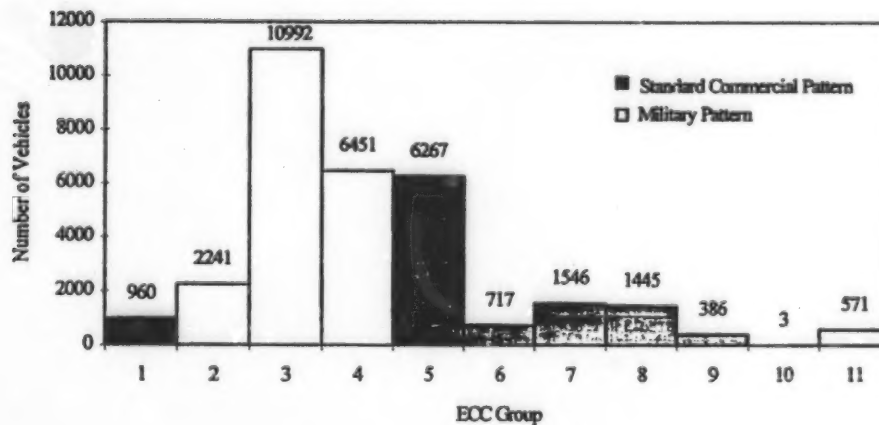


Figure 1: Number of Vehicles per ECC Group

Vehicles due for disposal were excluded from the holding

6. ECC group 5 is by far the most important group amongst the standard commercial pattern vehicles, representing 63% of them (excluding ECC group 8). ECC group 5 consists of the general purpose vehicles used for transporting passengers or cargo. This group is also the one whose utilisation is the most comparable to the industry. However for comparison purposes ECC numbers are too detailed while ECC groups are too broad. Thus ECC group 5 was subdivided into the sub-groups described in Table II. These sub-groups are essentially groups of industry-like vehicles except for sub-group 0. Four of them carry passengers, another four carry cargo.

TABLE II
GENERAL PURPOSE VEHICLES (ECC GROUP 5) SUB-GROUPS

Sub-Group	Description	
0	other (unique to DND)	
1	sedans	
2	station wagons	Passenger Vehicles
3	buses	
4	vans (Passenger)	
5	light trucks 1-3T	
6	light trucks 5-15T	Cargo Vehicles
7	highway tractors	
8	pick-ups, vans(Cargo)	

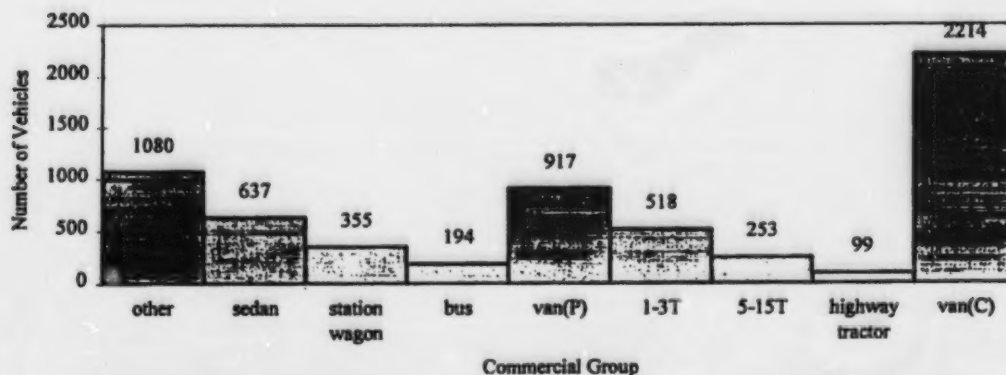


Figure 2: Number of Vehicles per Commercial Group (ECC group 5)

7. The actual mapping between ECC numbers and commercial sub-groups can be found in Annex A. The association between ECC numbers and commercial groups was based on the characteristics of the ECC and its equipment maintenance code. The number of vehicles in each of the commercial groups is presented in the histogram of Figure 2. Vans represent 50% of the general purpose vehicles.

III. SOME CONSIDERATIONS ON PERFORMANCE

8. In looking at the performance of the DND fleet, there are two obvious factors to consider i.e. the utilisation of vehicles and the utilisation of personnel since these are the main resources available. Of course there are other factors such as the consumption of fuel and spare parts. And there are more specific aspects like the efficient utilisation of the vehicles and the people. By this, we mean whether the cargo vehicles are less than half empty during the operation of the vehicles, or if the drivers spend most of their time waiting for their trucks to be loaded. This first aspect should be easy to evaluate for dedicated cargo vehicles, the second one might not be. However, indications of driving time could be obtained from the hours a vehicle is dispatched and the number of kilometers travelled/covered, provided that the number of hours is calculated on the basis of the operational hours of the vehicle.

9. Evaluating the performance of the fleet can become a very complex exercise, depending on the level of detail that is considered. But no matter what level of detail is considered, care must be taken in the adoption of measures for the evaluation of the fleet.

10. Absolute measures of performance are unreliable. The total number of kilometres driven by the fleet in a year is such a measure. If this number grows over time, one might be led to think that the fleet performs better when it might not, depending on the changes in the number of vehicles. A better measure is the number of kilometres per vehicle.

11. Productivity measures or relative performance measures provide more meaningful representations of what is accomplished. Different productivity measures can be used. But all of them use a measure of output over a measure of input, i.e., a ratio of output to input.

The number of kilometres is a measure of output; it is what is produced. The number of vehicles is a measure of input; it is a resource.

12. There are total and partial productivity measures. A partial measure is a ratio of output to just one input, while a total productivity measure is a ratio of output to all inputs. From a practical point of view it is difficult to add dissimilar units of resources, and often all the information is not available. Thus partial productivity measures, although incomplete, are more frequently used. References [4] and [5] provide good discussions on productivity measures.

13. Productivity measures over time. Productivity measures are useful on a number of levels. One such level is to track performance over time. It helps to judge performance and decide where improvements are needed.

14. Productivity measures as they relate to competitiveness. If two units (two bases, or DND versus the industry) have the same level of output but the former requires less input, then it is more competitive. How well one does relative to another in terms of the amount produced relative to the resources used is a measure of competitiveness. We want to get the best bang for the buck and we want to know what bang we get in comparison with others, so that we get a sense of the order of improvements that are possible.

IV. VEHICLE UTILISATION

15. Three measures of vehicle utilisation were evaluated:

- a. the number of vehicles used over the total number of vehicles;
- b. the number of kilometres driven per month per vehicle; and
- c. the hours of ready time per month per vehicle.

There were potentially more measures which could have been derived from pcBATOPS, i.e., the number of passengers and the weight of cargo per trip relative to the capacity of the vehicle, but these fields are not populated. Also the VMIS information system is not updated by the bases as regularly as it should be, and the quality of the information is at times questionable. For example, the odometer reading for a given vehicle was observed to occasionally decrease over time. The kilometres driven in a month for a vehicle could exceed 16 000 km, i.e., the equivalent of 8 hours a day, 5 days a week, 4 weeks a month, at 100 km/hour. A prototype information system which integrates VMIS, pcBATOPS, and the Vehicle Safety program is currently being tested at a number of trial sites across the country. The new system will better respond to the needs of the user, and will assist both command and national level headquarters in collecting data for the purposes of performance measurement.

16. For the purposes of this evaluation, the VMIS data were purged of all records where the number of kilometres per month exceeded 16 000 km. Information prior to 1995 was ignored, the system having been implemented only in 1994. Moreover, only records where the number of kilometres driven per month or the vehicle-off-the-road hours were positive were kept, i.e., only those entries where the vehicle showed to be in use (moving or waiting to be repaired/being repaired) were kept.

17. **Basic Utilisation.** Of those vehicles that are owned by DND, a certain percentage was used during 1995 and 1996. Here basic usage means that on at least one occasion during this period of time the vehicle was either driven for a few kilometres or was off the road for maintenance. The absence of usage for some vehicles can represent just that, or the failure to report the usage. Figure 3 illustrates the basic usage made of the vehicles by ECC groups, while Table III provides their utilisation rates (the ratio of the number of vehicles used over the number of vehicles). For the military pattern vehicles (groups 2, 3, 4, and 11) we notice very low utilisation rates, these vehicles are not being monitored very closely. The trailers, trailer type shelters and locomotives (groups 6, 8, and 10) will not be looked at because the usage of trailers is not systematically reported, only their tractors' usage is, and there are only three locomotives. The groups of interest to DTM when it comes to utilisation are groups 1, 5, 7, and 9, i.e., the materiel handling equipment, general purpose vehicles, construction equipment, and fire fighting vehicles, all of which have utilisation rates of 80% or higher.

TABLE III

BASIC UTILISATION RATES

* indicates military type

ECC Group	Utilisation Rate (%)	Vehicle Group - General Description
1	89	Materiel Handling Equipment
2*	13	Armoured Vehicles
3*	11	Special Military Pattern (SMP)
4*	5	Trailers SMP
5	87	Personnel/Cargo Move, Standard Commercial (SC)
6	44	Trailers SC
7	80	Construction Equipment
8	0	Trailer Type Shelters
9	89	Crash/Fire Fighting Vehicles
10	67	Locomotives
11*	0	Light/Heavy Weapons

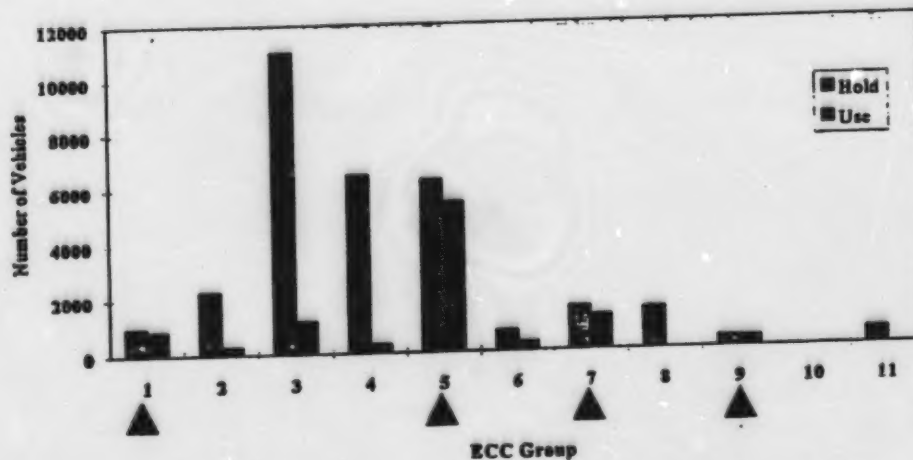


Figure 3: Basic Usage per ECC Group

18. The basic utilisation rates within the general purpose vehicles group, ECC group 5, are given in Table IV. The rates are very high notably for the station wagons, buses, vans (for cargo), and the sedans, all exceeding 90%.

TABLE IV

BASIC UTILISATION WITHIN GPVS

Sub-Group	Utilisation Rate (%)
other (unique to DND)	70
sedans	91
station wagons	99
buses	94
vans (PAX)	81
light trucks 1-3T	85
light trucks 5-15T	89
highway tractors	86
pick-ups, vans (cargo)	93

19. The number of kilometres driven per month per vehicle. The number of kilometres driven per month per vehicle was averaged within ECC groups 1, 5, 7, and 9. It is important to realise here that only the values for those vehicles which were in use in a given month were included in the average. A vehicle was considered to be in use if the vehicle had been moving for even a few kilometres (number of kilometres > 0) or if the vehicle was undergoing maintenance. Ideally one would average over all observations, i.e., whether the vehicle was used or was idle in the parking lot. The averages obtained for the forklifts (MHEs), GPVs, construction equipment, and fire fighting vehicles can be found in Table V. Note that the MHEs average is actually the hours of operation per vehicle per month. VMIS does not distinguish between the type of readings, i.e., kilometres or hours. The MHE's odometer readings are expressed in hours. It might be the case for some of the construction equipment or fire fighting vehicles.

TABLE V

AVERAGE NUMBER OF KM PER MONTH PER VEHICLE

**The MHE's average is in hrs per month per vehicle*

ECC Group	Group Description	Average
1	MHE	49.28*
5	Personnel/Cargo (SC)	1189.85
7	Construction Equipment	107.04
9	Crash/Fire Fighting Vehicles	66.71

20. The average number of kilometres per month per vehicle is of most interest within the general purpose vehicles category. Figure 4 illustrate the averages obtained along with the 95% confidence ranges and an industry average (expressed monthly) found in the Auditor General's report on Base/Wing Transportation [6]. For each vehicle group, the three diamonds on the figure represent: the lower value, the average, and the upper value for the DND average. There is a 95% chance that the true average for a group is between the lower and upper values.¹ Table VI lists the actual values obtained along with the industry average and the 1996 Auditor General's (AG) estimates of the DND averages.

¹ It is to be noted that the confidence that all of the true averages will fall within the 95% confidence intervals of all of the commercial groups indicated will be less than 95% [7]. If we assume independence between the groups, the probability of all true averages being in their respective 95% confidence intervals is the product of the probabilities of each true average being in its 95% confidence interval. The chance of being right simultaneously for all groups would be $(.95)^9 = 63\%$.

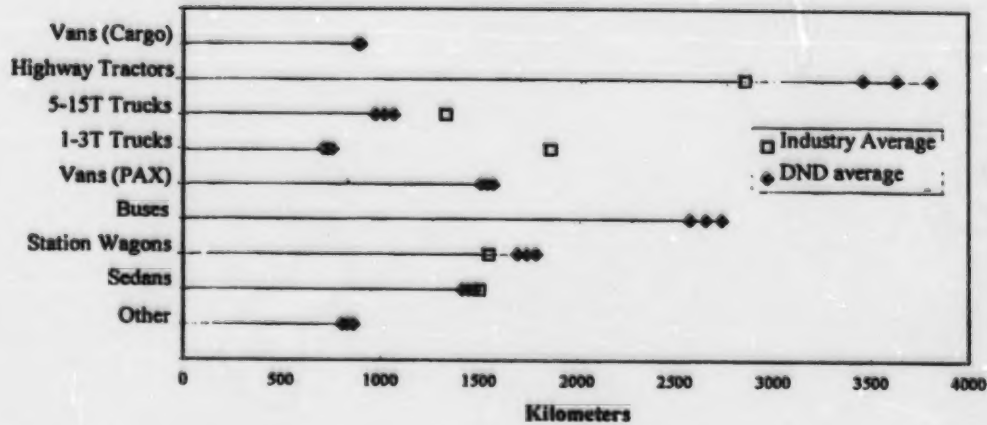


**Figure 4: General Purpose Vehicles category -
Average number of km per month per vehicle**

**TABLE VI
COMPARISON OF AVERAGES**

	DND average	Industry Average	DND average (Auditor General)
Pick-ups, Vans (Cargo)	891.99		
Highway tractors	3632.61	2853	3825
Light Trucks 5-15T	1021.02	1329	596
Light Trucks 1-3T	734.72	1860	1058
Vans (PAX)	1538.67		
Buses	2654.94		
Station Wagons	1741.42	1546	1947
Sedans	1444.20	1499	2030
Other (unique to DND)	836.25		

21. What can be concluded from this comparison is that our use of highway tractors and station wagons exceeds that of the industry (by 780 kms/mo and 195 kms/mo on average respectively); the sedans performance is close (differing by some 50 kms/mo); while that of the light trucks, the 1-3T and 5-15T is poor (being lower on average than the industry by 1125 kms/mo and 308 kms/mo respectively). Comparisons for the other type of vehicles such as the vans were not made by the Office of the Auditor General. Even though the DND averages obtained here are quite different from those of the Auditor General², the conclusions are similar.

22. Base-to-Base Comparisons. The average number of kilometers per month per vehicle along with its 95% confidence interval was determined for each commercial group for 26 bases and the Canadian Forces Support Unit (Ottawa) (CFSU(O)). The nine graphs generated can be found in Annex B. These allow us to see how much variation there is between bases. They show which ones perform better relative to the average and which ones perform worse. The bases always appear in the same order grouped by environment. When the number of observations for a base is lower than 10, no performance is shown. One notes that CFB Goose Bay's performance is lower than the average for all of the commercial groups, while CFB Calgary and CFB Moose Jaw exceed the average a good number of times. Some vehicle groups, such as the vans used to carry cargo, might do poorly in terms of the number of kilometers accomplished per month because the vehicle can be dispatched for reasons mostly other than transportation.

23. The hours of ready time per month per vehicle. This is probably the least reliable measure of the three. What is known about hours expended are the hours in a month:

- a. the vehicle is off the road (VOR) awaiting or undergoing maintenance;
- b. an operator driven vehicle is on dispatch; and
- c. a user driven vehicle is on loan.

² The AG used data from pc BATOPS for several Bases/Wings, but not all of them. Their study was limited to FY 95/96. They used odometer readings to get their averages.

The hours left in a month represent the hours the vehicle is ready to operate and is idle. The average hours expended for ECC groups 1, 5, 7, and 9 are illustrated on Figure 5, while the hours expended for the commercial groups (GPVs) can be found in Figure 6.

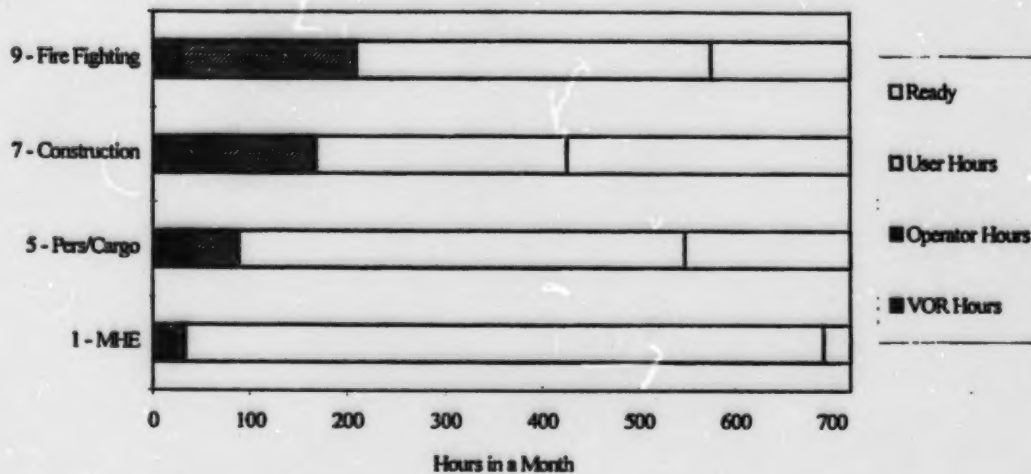


Figure 5: Average Hours expended by ECC Group

24. From Figure 5 we notice that the number of hours where an operator driven vehicle is on dispatch is greater for the construction equipment and the fire fighting vehicles, something that would be expected because these types of vehicles probably require special skills to operate.

25. However what is noticed from both Figures 5 and 6 is that the hours might not be expressed or compiled in a very practical way. It is understood that one cannot easily obtain the hours a vehicle is actually in operation. However if the vehicle is always operated between 08:00 and 17:00 then, from the point of view of performance analysis, it is on that basis that the hours should be compiled (instead of the current 24 hours a day) i.e. on the basis of the hours in a day (and the days in a month) that the vehicle may be in operation. The hours of ready time indicated in the figures may consist essentially of the hours at night that a vehicle is idle in a parking lot, hours which are not true valuable hours from a practical point of view.

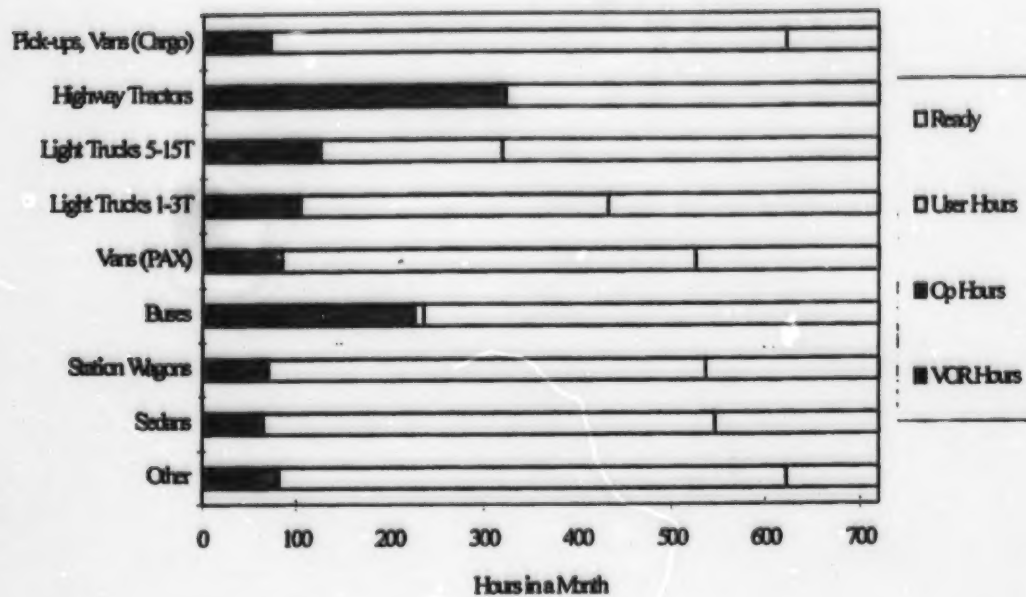


Figure 6: Average Hours expended by Commercial Vehicle Group

26. Despite high ready time, the buses and highway tractors (Figure 6) were highly used (their number of kms per month per vehicle was high) but mostly by operator drivers. The light trucks, particularly the 5 to 15T, appear not to be much used by either the operator drivers or the user drivers.

V. PERSONNEL UTILISATION

27. To evaluate the utilisation of personnel in base transportation, there was limited information. In VMIS, operator hours are recorded per month and by vehicle. There is no way of knowing what the average driver does in terms of hours dispatched and kilometers driven. However one aspect of the productivity of a base transportation section that could easily be addressed is to determine the number of people having a direct impact on its

productivity, i.e., the drivers, and the number of people supporting them, i.e., the non-drivers (including supervisors).

28. Information about personnel was requested from the base transportation sections by DTM from which the driver to overhead (i.e. non-driver) and driver to supervisor ratios were calculated. The detailed numbers can be found in Annex C. It is important to note here that some bases are undergoing radical changes in their transportation organisations and these will affect the ratios presented here. Moreover there may have been some misunderstanding as to which personnel falls under the title of supervisor. The supervisors in the Land Forces base transportation sections included dispatchers. Thus the driver to overhead ratio is the most reliable measure of the two. Figure 7 illustrates the results.

29. The drivers accounted for are the operator drivers as opposed to the user drivers which are drivers who do not belong to the base transportation section. It is understood though that a base transportation section that has a number of user drivers will have some additional administrative work which is not accounted for by considering only the operator drivers.

30. The driver to overhead at the bases could be compared with a benchmark of five taken from reference [6]. This benchmark is based on the numbers from only two branches of a major utility company. A ratio of five corresponds to five drivers for every supporting individual. CFB Goose Bay seems to be closest to that ratio while CFB Toronto, CFB Edmonton, and CFB London have the lowest ratios. More information on this utility company and its operations are needed to see how comparable their operation is to ours. Our own benchmark, the median of all the bases ratios is 2.2³.

31. The determination of the number of people working for a base transportation section follows guidelines described in reference [8]. Those guidelines are based on workloads measured by parameters like the number of operator drivers permits and the number of vehicles to deduce the number of people (by category: supervisor, driver, ...) that a given transportation section should have. Those figures might need to be revised if we want to increase the driver/non-driver ratios.

³ The median was used here as opposed to the mean because of the large variation in the numbers. The median provides a better measure of centrality.

Bases

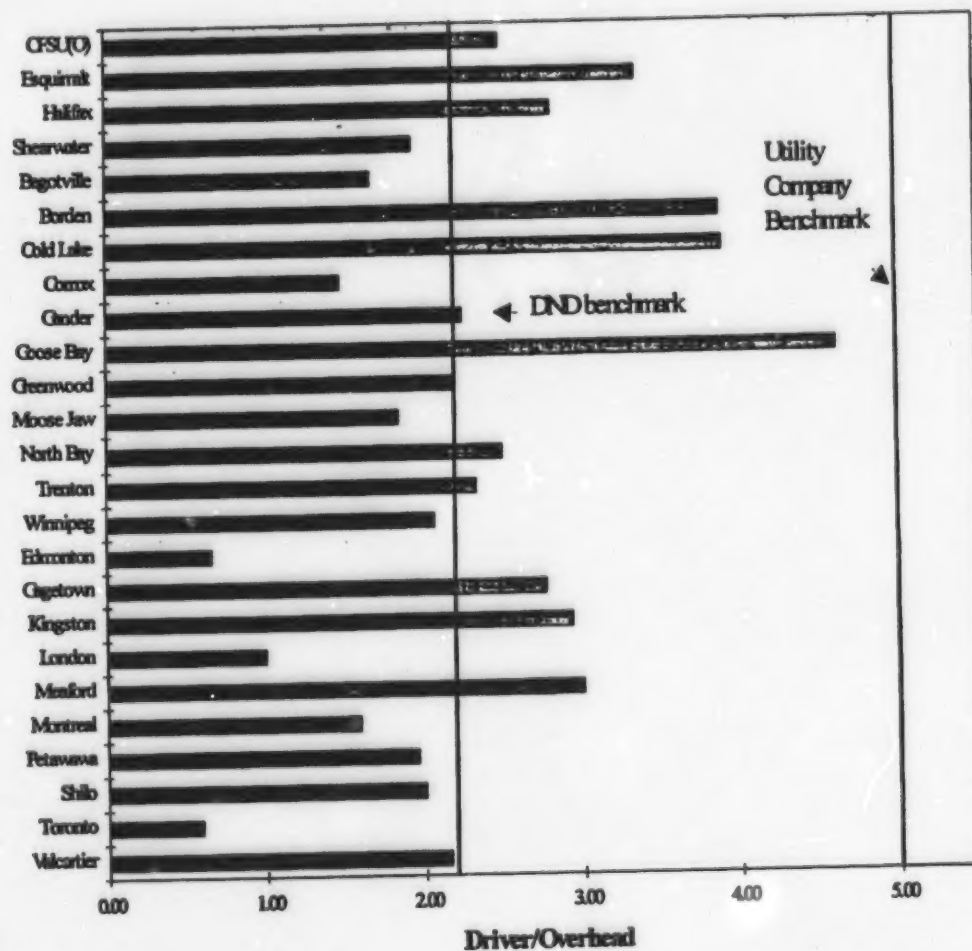


Figure 7: Driver to Overhead Ratios

VI. RECOMMENDATIONS

32. What follows is a series of recommendations that stem from the analysis of fleet management data and their particularities.

- a. A more meaningful categorisation of vehicles for all ECC groups is required such as was done for the general purpose vehicle category (ECC group 5). For example ECC group 1 on forklifts could be subdivided into different groups in accordance to the weight they can carry or the type of energy source they use (electricity, fuel);
- b. There is a need for more information on DND's competitors. There is a need to identify companies that use their vehicles (at least some of them) under similar conditions as ourselves. This could possibly be achieved through NAFA, the National Association of Fleet Administrators. Knowing more about competitors informs us about improvements that can possibly be made in fleet management and also provides benchmarks;
- c. Beyond the performance measures of the fleet which was the subject of this analysis, there is the use of taxis, the rental of equipment whose statistics would be worthwhile to look at in order to find not only the most effective and efficient solutions but also the most sensible economically;
- d. The user drivers could be requested to provide more information on their use of the vehicles. This would facilitate the analysis of the vehicles usage and back up the users claims for those vehicles. Currently all that is known is the number of kilometers accumulated in a month and the number of hours each vehicle was on loan, which often covers a whole month; and
- e. A review of the staffing guidelines would be desirable, since the supporting staff at a base transportation section is considerable compared to its number of drivers.

33. The next recommendations are more specific to the information gathering, particularly to the VMIS information system.

- a. The transfer of information from the bases to DTM should be automatic;
- b. An indicator should be present in the information system to identify whether usage reports are in kilometers or hours;
- c. The number of passengers on a trip or the weight carried should be recorded in the central database not only at the bases;
- d. The hours dispatched or on loan should be calculated two ways: according to the total number of hours the vehicle is dispatched or on loan, and according to the regular operating hours of the vehicle;
- e. If a vehicle is taken off the strength of a unit then there should be some safety checks preventing the vehicle from being reported by the unit in following months;
- f. Accident figures should be available not only at the bases but, also in the central database;
- g. The use of the trailers could be accounted for through the entries on the tractors, by simply adding one field for the CF Registration number of the trailer used by the tractor on one given trip;
- h. The raw information from the bases should be stored in the main database to allow the users to look at the information from many angles;
- j. The information system should be kept simple and should have as many safety checks as possible to avoid erroneous entries such as decreasing odometer readings. It is better to ask for less but reliable information, than to ask for a lot of information so poor in quality that little can be concluded from it.

VII. CONCLUSION

34. A review of the data on the management of the fleet revealed the nature of DND's holding. A few productivity measures were introduced and evaluated. It showed that for some categories of commercial-like vehicles, i.e., station wagons, highway tractors, the DND fleet has higher usage than the industry while for some, such as the light trucks, either 1-3T or 5-15T, the DND fleet's usage is low. Comparisons were also made amongst bases on the vehicles performance, and the personnel utilisation. More conclusions could have possibly been drawn if the raw data was available. The information needed has been identified, but is not systematically collected and it is sometimes manipulated in such a way that inferences are difficult to make. A prototype information system is being tested which should take into consideration the shortcomings identified here.

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ANNEX A
ORD PROJECT REPORT PR-9710
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**MAPPING OF ECC NUMBERS
TO COMMERCIAL SUB-GROUP NUMBERS**

Sub-Group	ECC Number
1	140101
1	140102
1	140104
1	140108
0	140110
1	140112
4	140113
0	140115
4	140116
4	140117
4	140120
2	140123
2	140124
1	140125
1	140127
1	140130
4	140131
4	140135
4	140136
4	140137
2	140142
2	140143
2	140144
4	140145
4	140146
4	140147
4	140148
0	140149
0	140150

Sub-Group	ECC Number
0	140153
0	140209
0	140212
0	140213
0	140218
0	140221
0	140222
0	140225
0	140227
0	140230
0	140231
0	140233
0	140234
0	140250
0	140251
0	140252
0	140299
0	140300
0	140301
0	140312
0	140313
0	140314
0	140315
0	140316
3	140505
3	140507
3	140527
3	140528
3	140529

Sub-Group	ECC Number
3	140532
3	140535
3	140536
3	140542
3	140544
3	140547
3	140555
3	140556
0	140601
0	140602
0	140701
0	140914
1	140916
1	140917
1	140918
1	140919
0	140922
4	140925
3	140927
0	141103
0	141105
0	141106
0	141109
0	141110
0	141111
8	142101
8	142103
8	142105
8	142106

Sub-Group	ECC Number
8	142107
8	142109
8	142112
8	142113
8	142114
8	142115
8	142118
8	142120
8	142122
8	142126
8	142127
4	142129
8	142130
8	142301
8	142303
4	142304
8	142350
8	142351
8	142352
8	142353
0	142400
8	142501
8	142504
8	142907
8	142908
8	143100
8	143101
8	143102
8	143103
8	143104
8	143105
8	143106
8	143107
0	143109
8	143110
0	143111
8	143113
8	143114
8	143115
4	143116
8	143117

Sub-Group	ECC Number
8	143119
8	143120
8	143121
5	143122
5	143150
5	143151
5	143152
5	143153
5	143154
5	143155
5	143156
0	143157
5	143158
5	143160
5	143162
5	143163
5	143200
5	143201
0	143202
5	143203
0	143205
5	143207
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5	143213
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0	143218
5	143219
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5	143221
5	143222
0	143224
0	143225
5	143226
0	143227
0	143300
0	143301
0	143302

Sub-Group	ECC Number
0	143303
0	143501
5	143502
0	143505
0	143508
5	144107
6	144108
5	144109
6	144110
5	144112
0	144114
0	144201
5	144902
0	145101
5	145106
5	145108
6	145110
6	145111
5	145115
5	145121
5	145125
6	145137
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6	145140
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5	145142
5	145143
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5	145145
5	145146
5	145147
6	145148
5	145150
5	145151
6	145154
6	145155
6	145156
0	145157
5	145158
5	145160
6	145162

Sub-Group	ECC Number
6	145163
6	145165
6	145166
6	145170
0	145199
6	145201
6	145203
0	145204
0	145205
0	145212
0	145213
0	145215
5	145218
0	145220
0	145247
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6	145251
6	145254
6	145255
6	145256
0	145257
0	145258
6	145259
0	145260
0	145261
0	145262
0	145264
0	145265
0	145914
0	145953
0	146106
6	146130
0	146131
6	146200
6	146901
6	146902
6	146903
6	146912
6	146913
6	146915
6	146916

Sub-Group	ECC Number
0	147106
0	148107
7	148120
7	149101
7	149102
7	149103
7	149106
0	149112
7	149115
7	149116
0	149150
7	149911
7	149912

GRAPHS OF THE NUMBER OF KMS PER MONTH PER VEHICLE IN THE COMMERCIAL GROUPS - COMPARISON AMONGST BASES

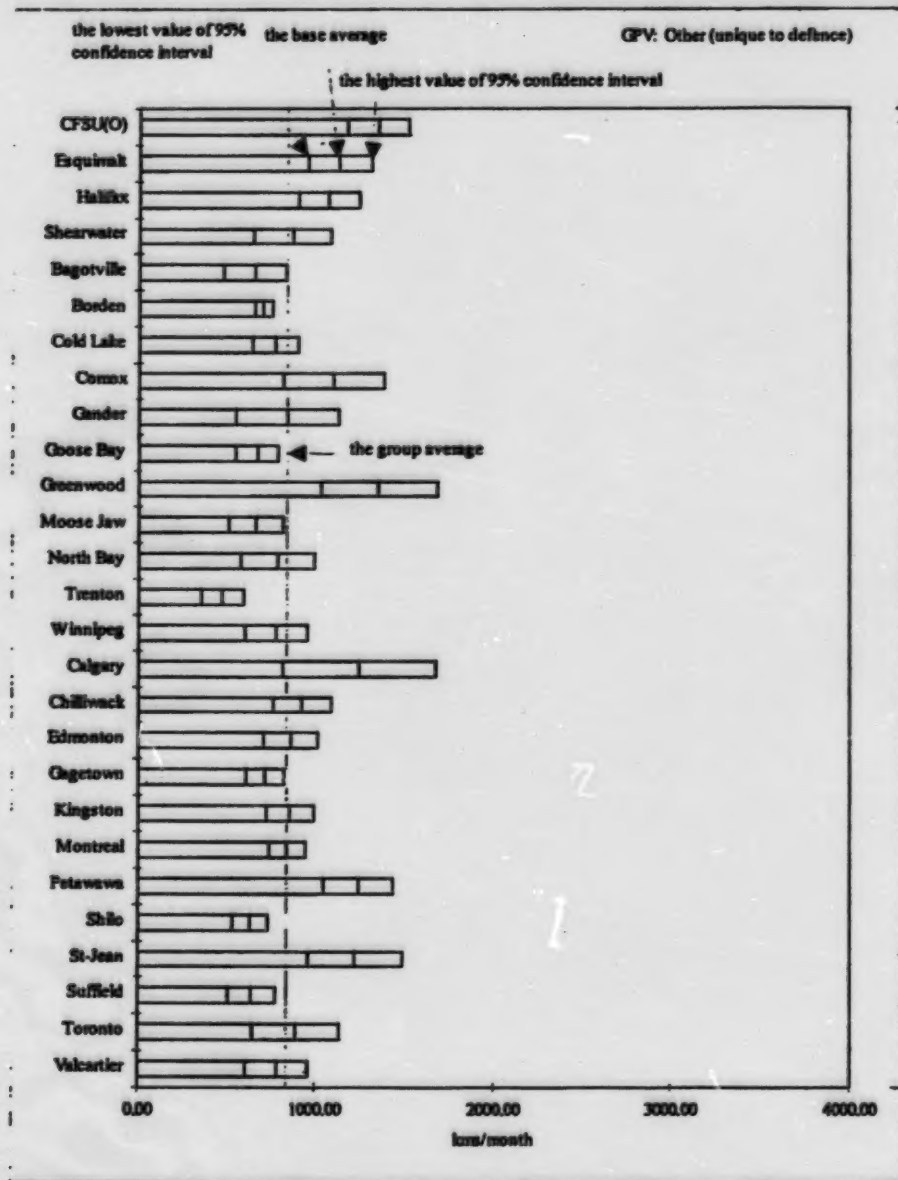


Figure B1: Kms/Month for Vehicles in Group Other (Unique to Defence)

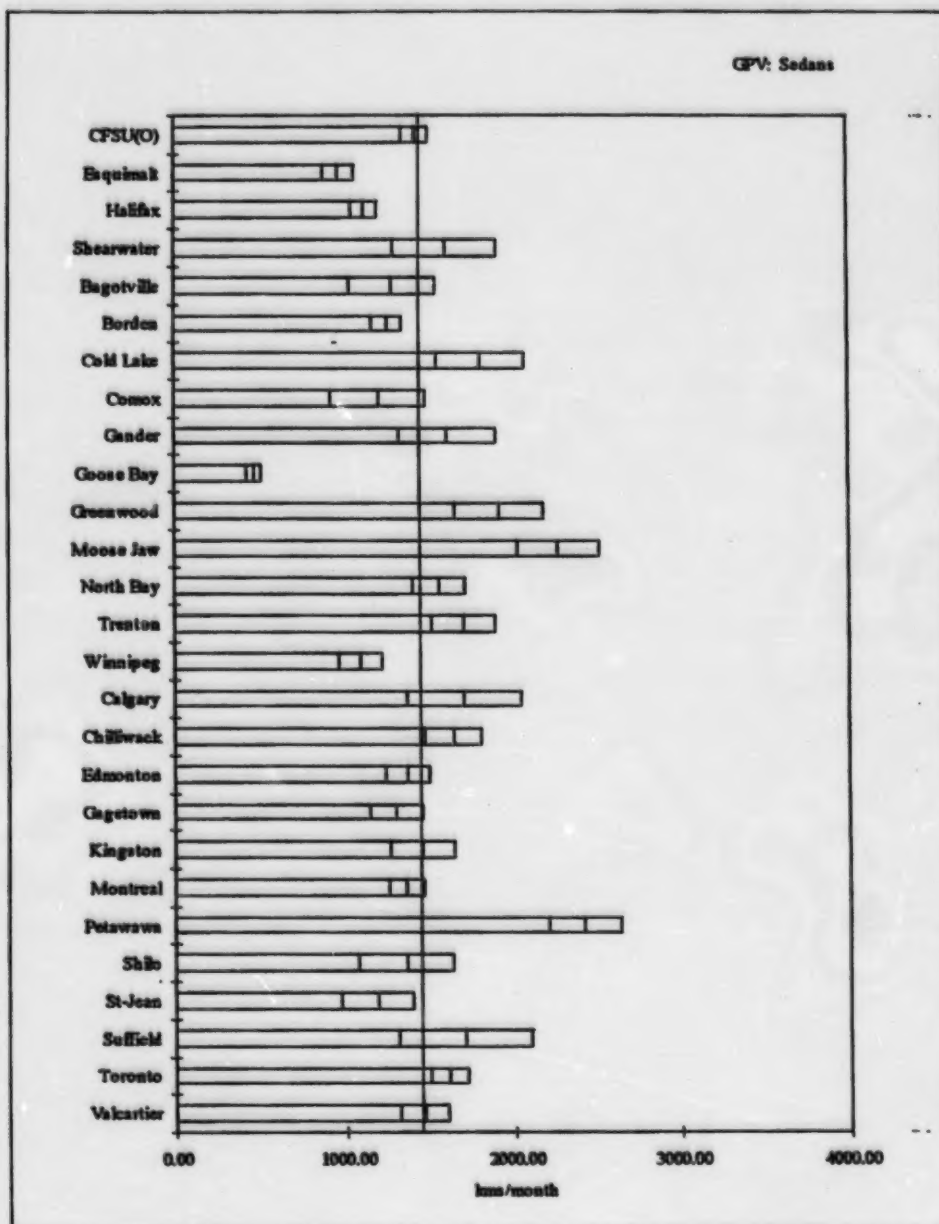


Figure B2: Kms/Month for Vehicles in Group Sedans

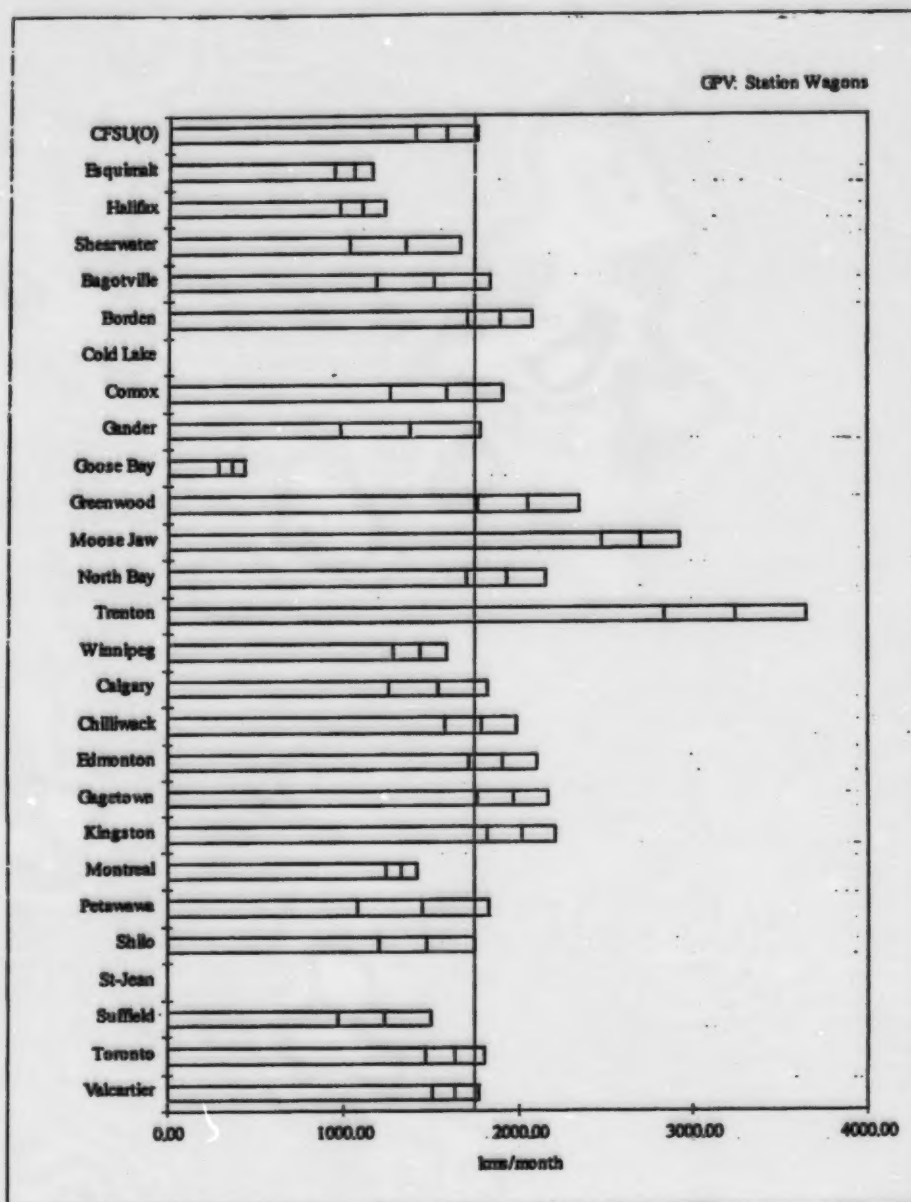


Figure B3: Kms/Month for Vehicles in Group Station Wagons

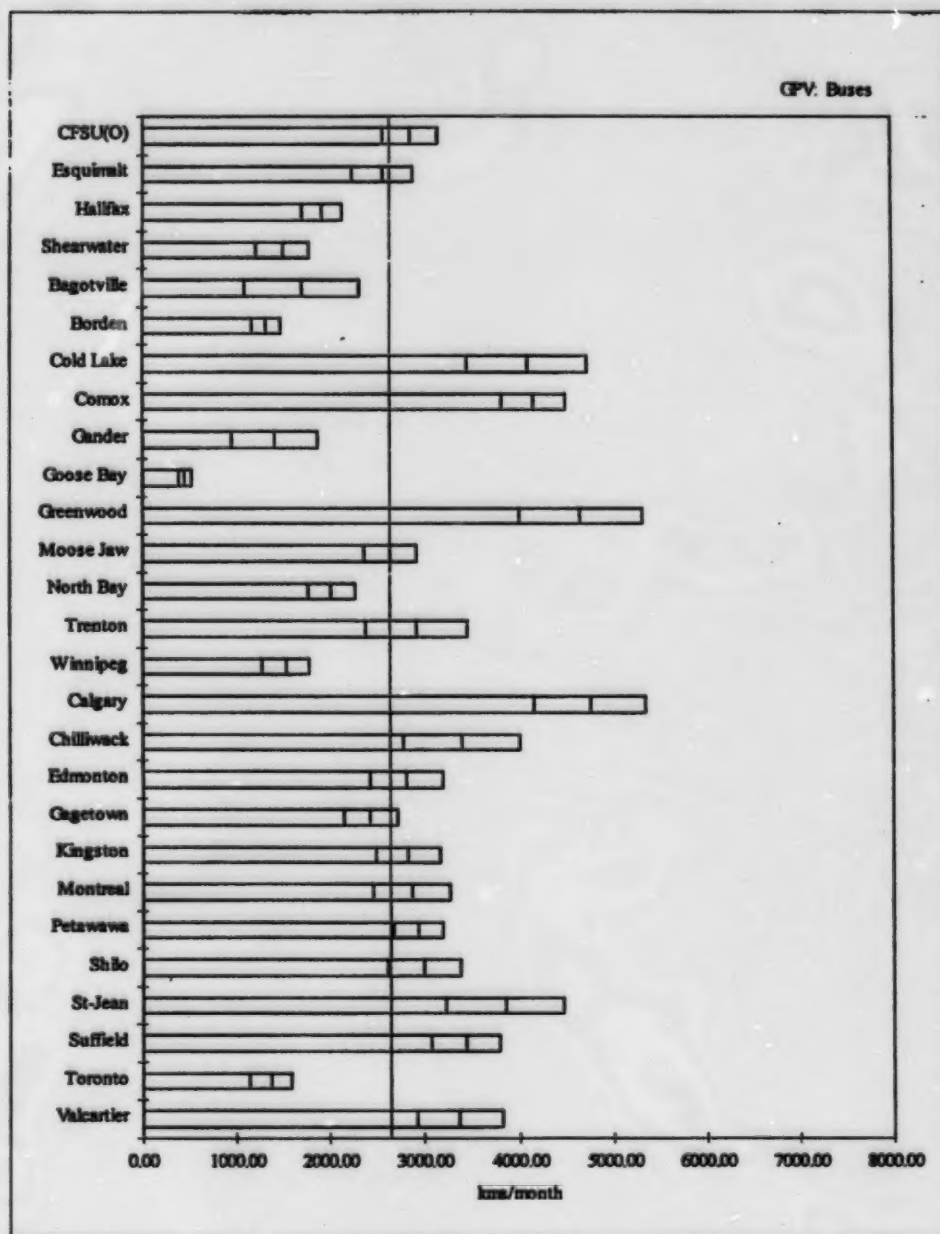


Figure B4: Kms/Months for Vehicles in Group Buses

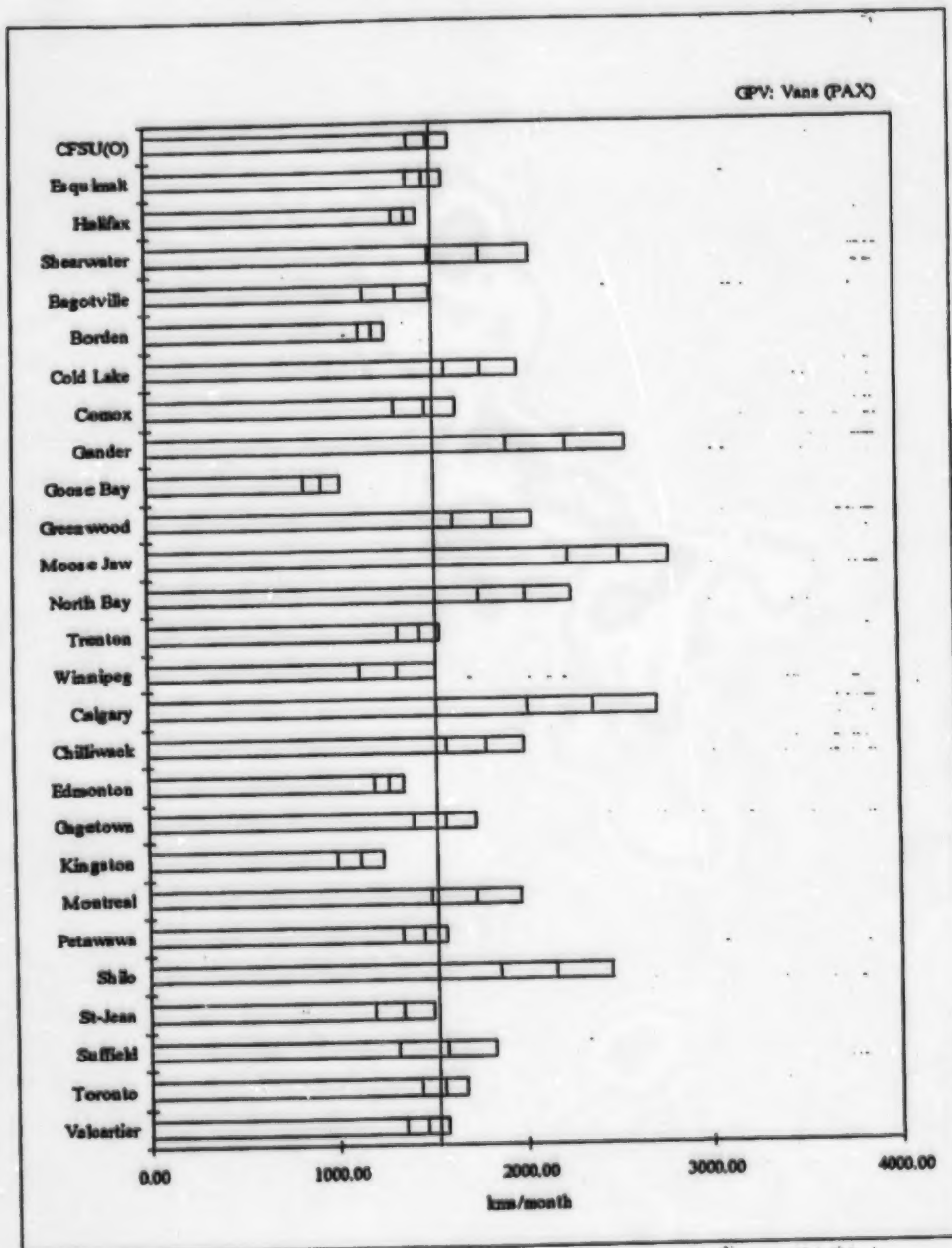


Figure B5: Kms/Months for Vehicles in Group Vans (PAX)

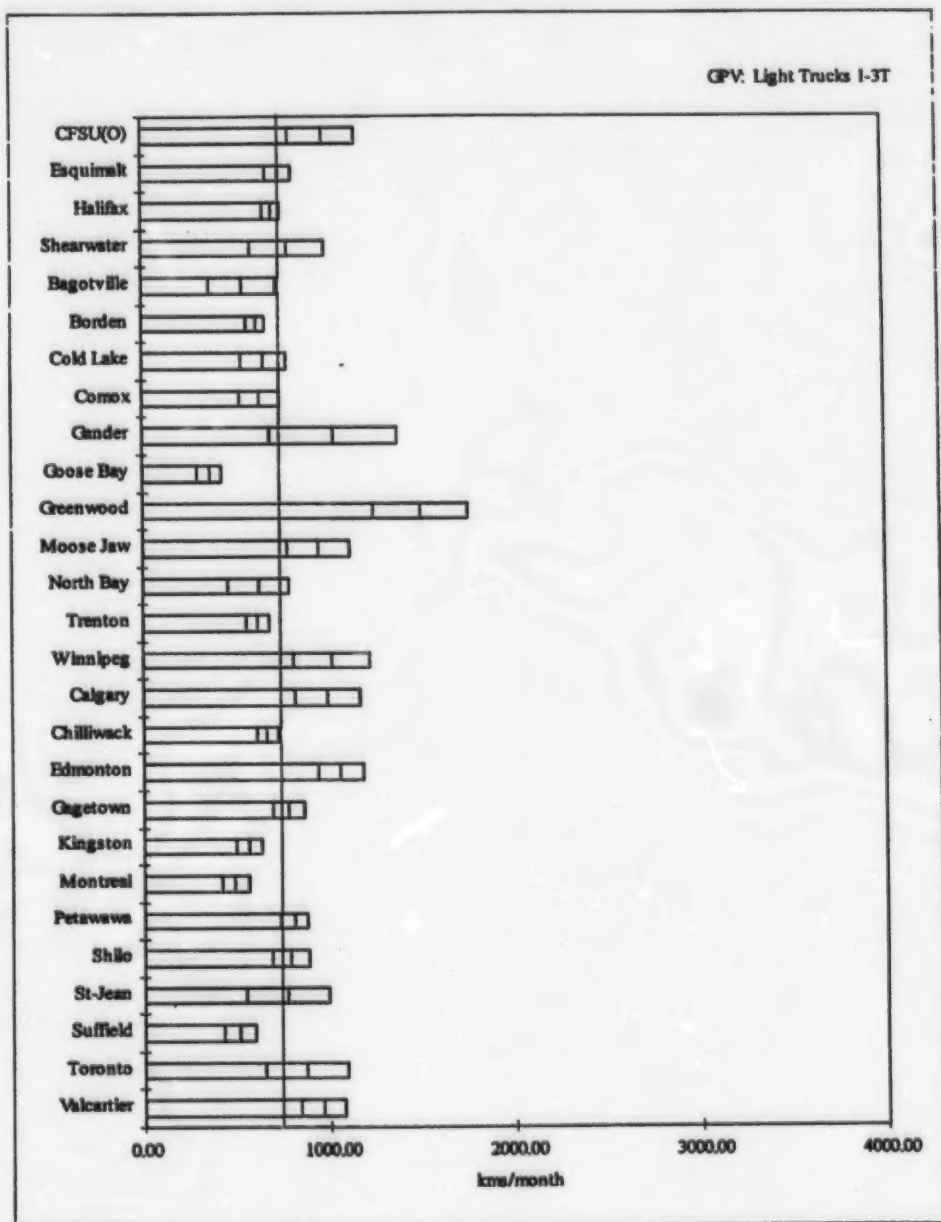


Figure B6: Kms/Month for Vehicles in Group Light Trucks 1-3T

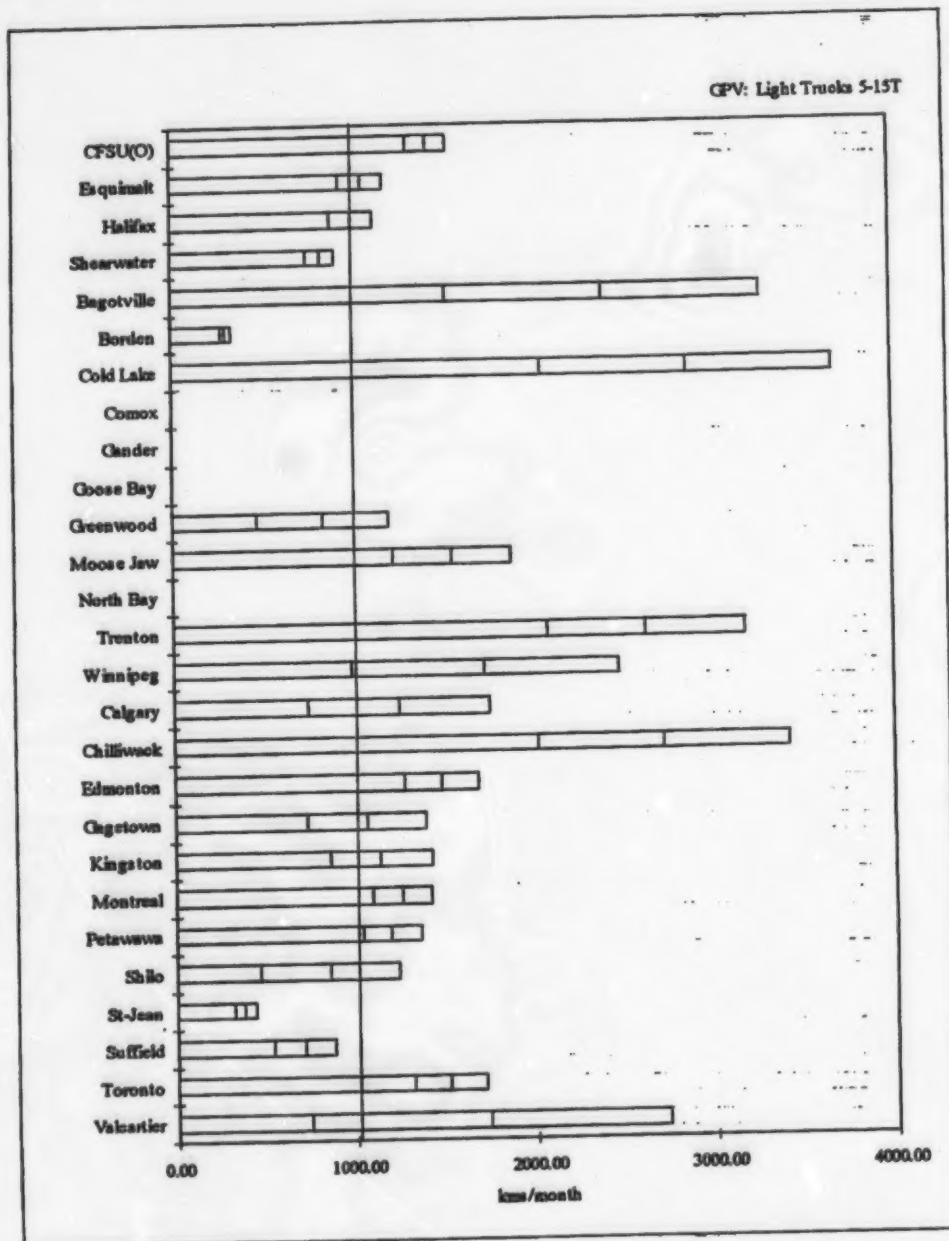


Figure B7: Kms/Month for Vehicles in Group Light Trucks 5-15T

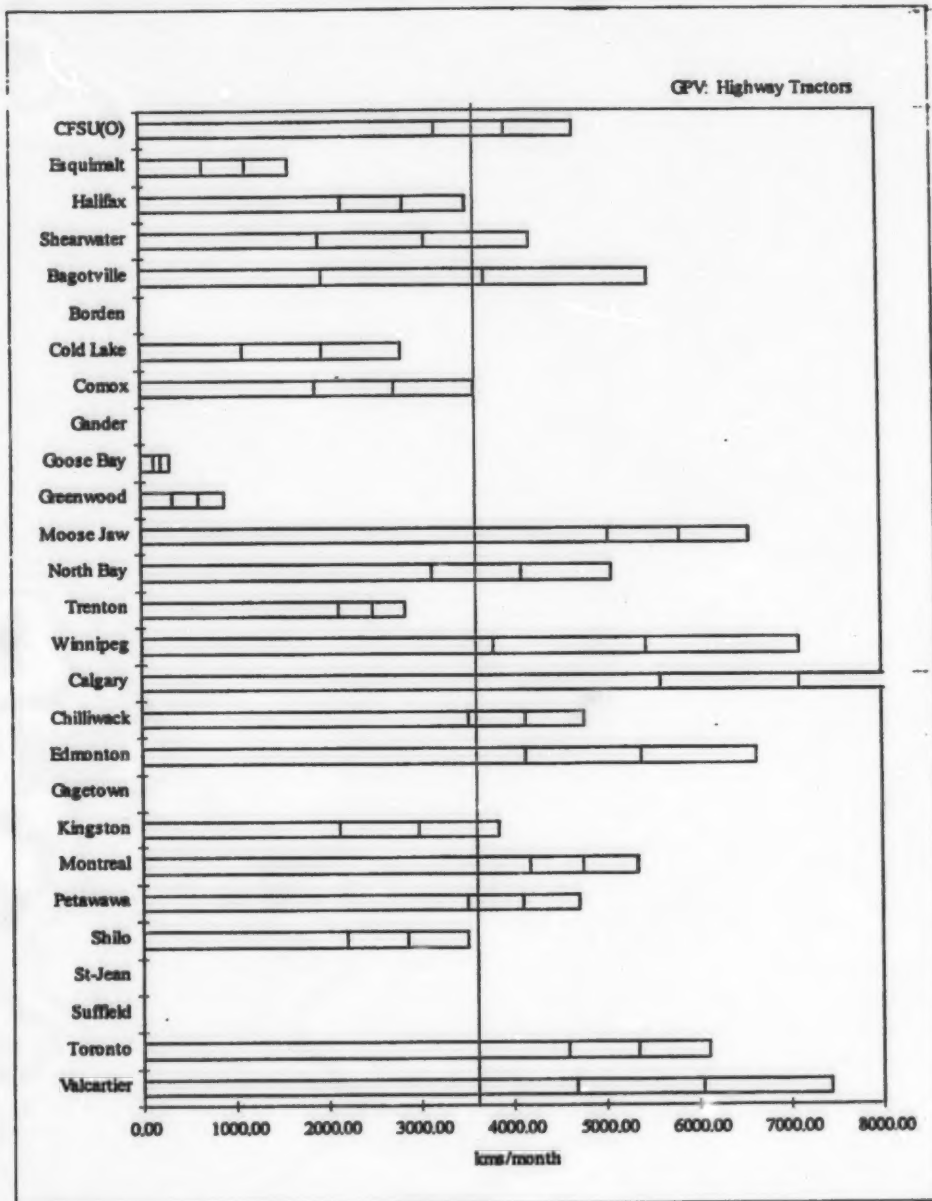


Figure B8: Kms/Month for Vehicles in Group Highway Tractors

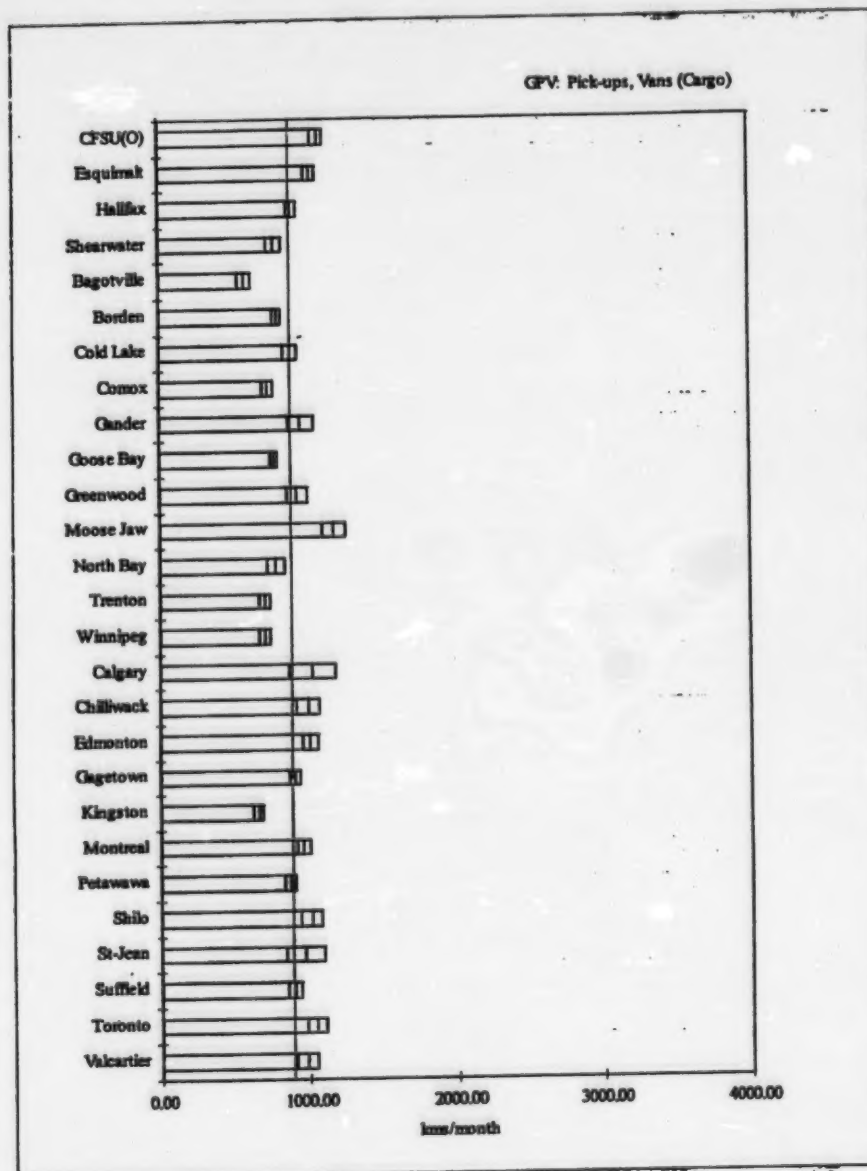


Figure B9: Kms/Month for Vehicles in Group Vans (Cargo)

ANNEX C
ORD PROJECT REPORT PR-9710
OCTOBER 1997

PERSONNEL FIGURES FOR BASE TRANSPORTATION SECTIONS

Environment	Base	Supervisors	Drivers/Ops	Drivers (seasonal)	Overhead (incl. sup.)	Driver/ Overhead	Driver/ Supervisor	Comments
	CFSU(O)	15	60		24	2.50	4.00	
Navy	Esquimalt	5	45	12	17	3.35	11.40	
	Halifax	16	93		33	2.82	5.81	
	Shearwater	9	31	2	17	1.94	3.67	
Air	Bagotville	21	37	6.5	26	1.67	2.07	
	Borden	17	93		24	3.88	5.47	
	Cold Lake	19	85	4.5	23	3.89	4.71	
	Comox	16	31		21	1.48	1.94	
	Gander	3	9		4	2.25	3.00	
	Goose Bay	5	26	15.5	9	4.61	8.30	
	Greenwood	14	46	4.5	23	2.20	3.61	
	Moose Jaw	16	34	1	19	1.84	2.19	
	North Bay	4	10		4	2.50	2.50	
	Trenton	23	68	2	30	2.33	3.04	
	Winnipeg	14	64		31	2.06	4.57	
Land	Edmonton	1	2	2	6	0.67	4.00	Supervisors include
	Georgetown	16	86		31	2.77	5.38	dispatchers
	Kingston	10	47		16	2.94	4.70	Georgetown took the initiative to calculate
	London	2	2		2	1.00	1.00	the % of time supervisors and sp pers.
	Meaford	2	6		2	3.00	3.00	spend on tpt duties. The figures were
	Montreal	13	43		27	1.59	3.31	adjusted.
	Petawawa	12	49		25	1.96	4.08	Edmonton and Montreal have fully adopted
	Shilo	9	32		16	2.00	3.56	the LFC ASG/ASU org. concept.
	Toronto	3	3		5	0.60	1.00	Calgary & Chilliwack closing in 97
	Valcartier	12	56		26	2.15	4.67	

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PERFORMANCE MEASURES FOR THE DND FLEET OF MOBILE SUPPORT EQUIPMENT

4. AUTHORS (last name, first name, middle initial)

PROVENCHER, M.

5. DATE OF PUBLICATION (month Year of Publication of document)
OCTOBER 1997

6a. NO OF PAGES (total containing information. Include Annexes, Appendices, etc.)

41

6b. NO OF REFS (total cited in document)

8

7. DESCRIPTIVE NOTES (the category of document, e.g. technical report, technical note or memorandum. If appropriate, enter the type of report e.g. interim, progress, summary, annual or final. Give the inclusive dates when a specific reporting period is covered.)

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020/96 - 3561-LDO-G

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Data on the Department of National Defence (DND) fleet of vehicles were analysed from the point of view of performance analysis. The report identifies productivity measures in fleet management. These measures are applied to actual data and their validity, accuracy, and completeness as a set of measures are discussed. Utilisation measures were evaluated and showed that the DND fleet performs better than the industry for some commercial-like vehicles such as station wagons and highway tractors. The performance of light trucks however is below industry average. It was also noted that the median base transportation section has about two drivers for every support individual. Improvements need to be made on the quality of the information gathered and the way it is compiled.

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